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ABSTRACT

Most college students who major in psychology are required to take an introductory statistics course. This course requirement often elicits anxiety because students believe that statistics is a difficult subject, involves lots of math, and is not relevant to their career goals. The first perception is accurate. Statistics is a demanding subject. However, the other two perceptions are not true: the required mathematics is quite basic, and statistics is an indispensable tool for understanding psychological knowledge. A number of proven teaching techniques are described for changing students' incorrect perceptions about statistics. Also discussed are teaching techniques fro reducing test anxiety, increasing student-teacher interaction, reducing rote memorization, getting students to read assignments on time, and promoting frequent reviews that lead to better long term retention. (Author)

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Teaching Introductory Statistics: Some Things I Have Learned

Roger E. Kirk

Abstract

Most college students who major in psychology are required to take an introductory statistics course. This course requirement often elicits anxiety because students believe that statistic is a difficult subject, involves lots of math, and is not relevant to their career goals. The first perception is accurate—statistics is a demanding subject. However, the other two perceptions are not true: the required mathematics is quite basic, and statistics is an indispensable tool for understanding psychological knowledge. A number of proven teaching techniques are described for changing students' incorrect perceptions about statistics.

Also discussed are teaching techniques for reducing test anxiety, increasing student-teacher interaction, reducing rote memorization, getting students to read assignments on time, and promoting frequent reviews that lead to better long term retention.

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Teaching Introductory Statistics: Some Things I Have Learned

Roger E. Kirk

I want to focus on the introductory statistics course, probably the most dreaded course in the psychology major. I teach the course in a large lecture hall that has multimedia equipment with two large screens at the front of the hall. The course has a maximum enrollment of 110 students, and after drop-adds, stabilizes at around 100. Students also enroll in one of five labs with a maximum enrollment of 22. After teaching the course twice a year for over forty years and writing three introductory statistics books, I have identified a number of variables that are related to success in the course.

One variable is the student's attitude toward taking the course. On the first and last day of the semester, I administer a sentence completion attitude survey that measures such things as attitude toward taking the course, the place of statistics in a student's career goals, and so on. The attitude surveys are reproduced in Tables1 and 2. What I discovered from

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Insert Table 1

Insert Table 2

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the surveys is that almost all students dread taking the course. A random sample of responses from my spring semester class to the sentence stem "When I realized that I had to take this course, I , , ," are shown in Table 3. Frankly, the first time I administered the

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Insert Table 3

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survey I was surprised by the amount of anxiety that the course elicited. I knew that students tended to put off taking the course, but I didn't know how much they dreaded it. Each semester as I analyze the survey results, I feel a twinge of envy for my colleagues who teach abnormal psychology and other popular psychology courses.

Why are students so apprehensive about taking the course? There are a number of reasons. I will focus on three reasons that are frequently mentioned in the attitude survey. First, the course is known to be demanding. Second, students think that statistics involves lots of math and many students feel inadequately prepared in this area. Third, students are interested in and want to take courses that have a psychological content; statistics is not psychology and hence is not perceived as relevant to their career goals.

The Statistics Course Is Demanding

As teachers, we have to deal with these perceptions. On the first point—that the statistics course is demanding—I have to agree. Statistics is a complex subject that requires learning a new vocabulary and using thought patterns that are foreign to many students.

There is another reason why the course is demanding and that is the phenomenal growth of statistical knowledge. Today, I teach concepts to sophomores that 40 years ago were reserved for graduate students. Also, when I took my first statistics course, a lot of time was devoted to the computational aspects of statistics. Today, calculators and computers have taken over this function. Now we can concentrate on covering more concepts, but the concepts are the hard part of statistics.

Concern About Poor Math Skills

The second point—that statistics involves a lot of math—is not true at the level that statistics is taught in the sophomore course. When I was writing my first introductory statistics book, I spent some time identifying the math and algebraic operations that were used in my course. I then developed a 48 item test to measure these math skills. An examination of my test reveals that the required math skills are pretty basic. But this isn't very reassuring to students who have forgotten most of their high school algebra. My solution to this problem is to use the math skills test to discover which operations students have forgotten and then require them to learn the operations. The math test is administered during the first lab period. My introductory statistics textbook contains a review of math that is keyed to the skills test. Students who do not achieve a passing score on the test are

required to study the concepts that they don't understand and take alternative forms of the math test until they achieve a passing score.

Passing the test has a motivating effect—students gain confidence in their math skills and confidence that they can succeed in the course. After I instituted the test, I noticed a significant decrease in the number of in-class questions concerning mathematical operations.

Statistics Is Not Relevant to Students' Career Goals

The third point—that statistics is not psychology and hence is not relevant to their career goals—is a widely held perception. I use a variety of techniques to confront and change this perception. For example, I introduce each new statistic with a real life example of the way the statistic is used in psychology. Many of the examples are drawn from my statistical consulting practice.

Another technique I use is to project images of interesting psychology articles on two large screens at the front of the lecture hall. I moderate a discussion of the article and its use of statistics. It doesn't take long for students to realize that at the very least they will have to be consumers of statistics. I reinforce this idea by giving students the option of earning bonus points on each exam by finding examples of selected statistics in APA journals and summarizing in a paragraph or two the information conveyed by the statistic. This technique has been very successful—about 85% of the students earn bonus points, and I hope an appreciation for the pervasiveness of statistics in psychology journals.

I want students to leave my course with an understanding of important statistical concepts and the ability to read and understand statistical presentations. Too often in lecture courses, students are preoccupied with note-taking and fail to see how ideas are related. To minimize the need to take notes, I project an outline of my lecture on two screens in the front of the lecture hall. Students are encouraged to download the outlines from my web page.

Students are told in the syllabus that they should read the assigned material in the

textbook prior to attending the lecture over the material. I want students to be able to enter into a discussion of the topic at hand. As you know, students, left to their own devices, tend to procrastinate. When this happens, they get less from the lecture than they should. Several years ago, I hit on the idea of giving five-minute quizzes in the lab prior to the lecture presentations. The quizzes consist of eight multiple choice questions drawn from the chapters to be covered in the next lecture. Needless to say, the quizzes have not been popular with students, but the improvement in their ability to follow the lecture and participate in class discussions has been dramatic.

Another thing that I have learned is the importance of TLC. Students need lots of tender loving care and assurance that they can succeed in the course. Although the large class room calls for a lecture format, I try to have as much dialog with the students as I can. I begin each lecture with a ten minute review of the most important points of the previous lecture. During this time, I encourage students to ask questions about anything that is not clear. For the remainder of the lecture, I intersperse questions to encourage a give and take exchange. I believe that it is important to have as much interaction with students as possible. To promote this, I give students my home phone number and e-mail address and encourage them to call or e-mail me any time they encounter something in the course that isn't clear.

A number of years ago, I accidentally discovered another way to increase my interaction with students. One day I got to the lecture hall ten minutes earlier than usual. Instead of standing at the front of the hall, I wandered up and down the isles. During this time, I had a number of conversations with students who never asked questions during class or called me at home. From that day on, the ten minute walk-around became a regular part of my pre-lecture routine.

Reducing Exam Anxiety

Students are especially apprehensive about the examinations in statistics. For some reason, they expect to have to memorize a lot of formulas. They are relieved to learn that

such memorization is not required. The textbook, Statistics: An Introduction (Kirk, 1999) that I wrote contains all the important formulas on the back end papers. I have Xeroxed those pages and provide a copy with each examination. This seemed to reduce test anxiety, so I decided to take it to the next level. Now students can bring a "memory jogger" to each examination. The memory jogger is a sheet of colored paper on which they can write anything that they think might be useful in taking the examination. Allowing students to use a memory jogger along with a copy of important formulas from the textbook helps to lower test anxiety, minimizes rote memorization, and encourages a focus on understanding concepts. According to students, preparing the memory jogger is an excellent way to study for the exams. I never knew that students could write so small. The amount of information that they cram onto one page is truly amazing. I am currently examining the memory joggers of the best and poorest students to see if I can detect differences in the kinds of information they write, the organization of the information, and so on.

Other Effective Teaching Techniques

It shouldn't come as a surprise to anyone in this audience that students learn statistics by doing statistics. Hence, I require a lot of homework in the labs. Students do their homework with the JMP® statistical package. Through a licensing agreement with SAS, students can purchase their own copy of JMP® at a nominal cost. Earlier, I discussed the importance of showing that statistics is relevant to psychology. The relevance of statistics is reinforced in the labs by selecting interesting experiments and data sets to be analyzed. The goal of homework is to answer thoughtful questions about human behavior rather than simply crunching numbers. Four of the lab assignments involve analyzing large data sets. For these assignments, students in each lab are randomly assigned to four-person groups. The groups, which change for each assignment, compete to produce the best statistical analysis and write the most professional results and discussion section. Each group has an opportunity to defend their analysis and to discover that there is often more than one correct way to analyze data. Members of the winning group receive points toward their course

grade.

Statistics like mathematics builds on a base of foundation concepts. Psychology, on the other hand, is less of a sequential discipline. For example, it doesn't matter whether you cover the perception chapter before or after the learning chapter. I think that the non-sequential character of psychology develops a mind-set in students to remember material just long enough to pass a test. In statistics, this can be fatal. To encourage my students to review earlier material and remember concepts for the long run, all of my exams are cumulative—each test covers the new material plus the old material. By the time students get to the final exam, they have reviewed the first section of the course four times. Needless to say, this is not a popular feature of the course, but it does promote retention.

I constantly search for better ways to teach statistics. I have found that my students are an excellent source of good teaching ideas. At the conclusion of each semester, I ask for anonymous written comments about things that I can do to improve the course and the way it is taught. I have gotten many great teaching ideas from the students who help to pay my salary.

Reference

Kirk, R. E. (1999). Statistics: An Introduction (4th ed.). Harcourt Brace: Fort Worth, TX.

Author Note

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Table 1 Attitude Survey: First Day of Class

ATTITUDE SURVEY

Name _____ First Major _____ Second Major _____

Year in School Fr ☐ Soph ☐ Jr ☐ Sr ☐

Gender Male ☐ Female ☐ ID No. ☐

Instructions: Complete the following sentences with the first thought that occurs to you. There are no right or wrong answers; simply respond with your first thought.

1. When I realized that I had to take this course, I . . .

2. I think that this course will be . . .

3. Math has always been something that . . .

4. I expect that my performance in this course will be . . .

5. As I see it, the main benefit of taking this course is . . .

6. Compared to most students in this course, I think that my math skills are . . .

7. What I expect to learn in this course is . . .

8. In terms of my career goals, this course . . .

9. Over the years, my interest in the basic sciences has . . .

10. When I was asked to complete this survey, I . . .

Table 2. Attitude Survey: Last Day of Class

ATTITUDE SURVEY

Name _____ First Major _____ Second Major _____

Year in School Fr ☐ Soph ☐ Jr ☐ Sr ☐

Gender Male ☐ Female ☐ ID No. ☐

Instructions: Complete the following sentences with the first thought that occurs to you. There are no right or wrong answers; simply respond with your first thought.

1. Now that this course is almost over, . . .

2. The thing that most surprised me about statistics is . . .

3. Because of this course, my interest in Math has . . .

4. The role of statistics in research . . .

5. As I see it, the main benefit of taking this course is . . .

6. In terms of my career goals, this course . . .

7. The thing I like least about statistics is . . .

8. When I was asked to complete this survey, I . . .

Table 3. Random Sample of Responses to the Sentence Completion Stem "When I realized that I had to take this course, I . . . "

was scared
panicked. I have heard horror stories about this course.
wanted to die
knew I'd have to take it twice
didn't understand what it had to do with psychology
asked my father for help since he is a psychologist
didn't have any idea what to expect. Everyone has told me that it's a killer.
was anxious
nervous but interested
knew it would be hard
was frightened
was apprehensive about the grading scale
knew I'd be facing a challenge
willingly took it
wasn't too thrilled
thought that if I wanted to be a psychologist I would have to take it and suffer through it
asked my friends how much they studied
dreaded it, because of the rumors I heard about the class
did not know what it was about
wasn't necessarily excited but hay, its necessary, must be important, so might as well do it
was not excited
wasn't really looking forward to it
wanted to cry
said, there goes my GPA

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